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Attorney Docket No.: 5865/CALB/COPPER

## Claims:

1. A method of monitoring and controlling manufacturing processes within a multi-step manufacturing system having independently operating tools that perform specific processes upon a workpiece, comprising:

testing a workpiece after one or more steps of processing within one or more independently operating tools;

generating control parameters for previous and subsequent processing steps that are to be performed or have been performed on the workpiece by the independently operating tools;

selectively supplying said control parameters to either the previous processing step or the subsequent processing step, or both to optimize the processing performed upon the workpiece.

- 2. The method of claim 1 wherein the workpiece is a semiconductor wafer and the independently operating tools are semiconductor wafer processing tools.
- 3. The method of claim 2 wherein the independently operating tools comprise one ore more of: etch chamber, chemical-mechanical polishing tool, electrochemical plating cell, a physical vapor deposition chamber and a chemical vapor deposition chamber.
- 4. The method of claim 1 wherein said testing step is performed by at least one metrology station.
- 5. The method of claim 4 wherein said at least one metrology station performs blanket wafer tests and patterned wafer tests.
- 6. The method of claim 2 wherein said semiconductor wafer processing tools comprise an electrochemical plating tool and a chemical mechanical polishing tool.
- 7. The method of claim 6 wherein said testing step measures a uniformity and thickness of a layer deposited upon the semiconductor wafer using the electrochemical plating tool.



- 8. The method of claim 7 wherein said generating step produces control parameters for said chemical mechanical polishing tool comprising a pad rotational speed and a pad center-to-edge pressure profile.
- 9. A method of monitoring and controlling manufacturing processes within a multistep integrated circuit manufacturing system having independently operating process tools that perform specific processes upon a semiconductor wafer, comprising:

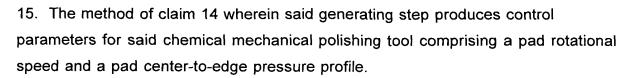
testing a semiconductor wafer after one or more steps of processing within one or more independently operating tools;

generating control parameters for previous and subsequent processing steps that are to be performed or have been performed on the semiconductor wafer by the independently operating tools;

selectively supplying said control parameters to either the previous processing step or the subsequent processing step, or both to optimize the processing performed upon the semiconductor wafer.

- 10. The method of claim 9 wherein the independently operating tools comprise one ore more of: etch chamber, chemical-mechanical polishing tool, electrochemical plating cell, a physical vapor deposition chamber and a chemical vapor deposition chamber.
- 11. The method of claim 9 wherein said testing step is performed by at least one metrology station.
- 12. The method of claim 11 wherein said at least one metrology station performs blanket wafer tests and patterned wafer tests.
- 13. The method of claim 9 wherein said independently operating process tools comprise an electrochemical plating tool and a chemical mechanical polishing tool.
- 14. The method of claim 13 wherein said testing step measures a uniformity and thickness of a layer deposited upon the semiconductor wafer using the electrochemical plating tool.

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16. A method of monitoring and controlling copper interconnect manufacturing processes within a multi-step copper interconnect manufacturing system having independently operating tools that perform specific processes upon a semiconductor wafer, wherein the tools include a barrier and seed layer deposition tool, a electrochemical plating tool and a chemical-mechanical polishing tool, comprising:

depositing a barrier and seed layer within a trench formed in the semiconductor wafer;

testing a barrier and seed layer thickness;

generating, in response to the barrier and seed layer thickness, first control parameters for the electrochemical plating tool and the barrier and seed layer deposition tool;

performing electrochemical plating to deposit a copper layer upon the barrier and seed layer in accordance with the control parameters; testing a copper thickness and resistivity;

generating, in response to the copper thickness and resistivity, second control parameters for the electrochemical plating tool, the barrier and seed layer deposition tool, and the chemical-mechanical polishing tool;

performing chemical-mechanical polishing upon the copper layer in accordance with the second control parameters;

testing a copper uniformity and residue of the polished semiconductor wafer; generating, in response to the copper uniformity and residue, third control parameters for the electrochemical plating tool, the barrier and seed layer deposition tool, and the chemical-mechanical polishing tool;

using the third control parameters in processing subsequent semiconductor wafers.

17. The method of claim 16 further comprising: etching the trench into the semiconductor wafer; testing a trench geometry; PATENT
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generating, in response to the trench geometry, fourth control parameters for the electrochemical plating tool, the barrier and seed layer deposition tool, and the chemical-mechanical polishing tool;

using the fourth control parameters to process the semiconductor wafer having the trench geometry.

18. Apparatus for monitoring and controlling a multi-step semiconductor wafer processing system comprising:

a plurality of independently operating processing tools;

at least one metrology station for testing a semiconductor wafer after one or more process steps are performed by the plurality of independently operating processing tools;

a metrology data analyzer for analyzing data produced by the at least one metrology station and producing control parameters for said plurality of independently operating processing tools;

a plurality of process controllers for selectively applying the control parameters to the plurality of independently operating processing tools.

- 19. The apparatus of claim 18 wherein said at least one metrology station performs blanket and patterned wafer tests.
- 20. The apparatus of claim 18 wherein the independently operating processing tools comprise one ore more of: etch chamber, chemical-mechanical polishing tool, electrochemical plating cell, a physical vapor deposition chamber and a chemical vapor deposition chamber.
- 21. The apparatus of claim 18 wherein the multi-step semiconductor wafer processing system produces a copper interconnect using independently operating processing tools comprising: a barrier and seed layer deposition tool, an electrochemical plating cell and a chemical-mechanical polishing tool.